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The Production and Utilization of Corn Grown under Irrigation in Washington

by

H. P. Singleton

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The Production and Utilization of Corn Grown Under Irrigation in Washington

By H. P. Singleton

INTRODUCTION

Throughout the United States as a whole, corn is thought of as the basic grain crop for livestock feed. In the state of Washington good corn is recognized as a very desirable feed crop but its production has been of little importance. According to the 1924 crop census there were approximately 40,000 acres of corn grown in the state. During the next five years the area dropped to about 32,500 acres. In 1929 the counties comprising the greater part of the irrigated area of the state, viz., Benton, Chelan, Kittitas, Okanogan, Spokane, Stevens, Walla Walla, and Yakima, grew approximately 55 per cent of the total acreage for the state. The largest corn acreage is in the lower Yakima valley, the counties of Yakima and Benton producing about 30 per cent of the total state acreage in 1929.

The demand for good corn for livestock and poultry feeding greatly exceeds the local supply, and corn must be secured from the Middle West. For this reason the retail price usually is relatively high in the state. Thus, corn growing should be profitable for the Washington farmers who are favorably located, providing good yields of high quality corn can be secured.

The Irrigation Branch Experiment Station, which is located in Benton county four and one-half miles northeast of Prosser, began studies with corn in 1922. The elevation at the station is from 800 to 890 feet. The growing season has approximately 155 frost-free days. Average annual rainfall is about seven inches, most of which occurs during the winter months. The soil at the Station is classified as Sagemoor fine sandy loam. Except as mentioned in the text, all data presented herein were obtained at the Station.

EXPERIMENTAL METHODS

Following is a summary of experimental methods used in corn studies:

Number of replications of plots: Single plots for varieties prior to 1927. Duplicates since 1927.

Size of plots: From one-fiftieth acre to one-tenth acre, depending upon area available. Large plots were used when plots were not duplicated. One border row on each side of plot.

Planting: Two row planter, rows 40 inches apart prior to 1931. Thirty-six inches apart in 1931 and 1932. Hills checked 42 inches apart.

Irrigation practice: Field irrigated before planting and sufficiently thereafter to insure uniform growth throughout the growing season. Total amount of water applied annually was about 30 acre inches.

Cultural practice: Cultivated with two-horse cultivator early in season. No cultivation after corn was two feet high. Weeds kept down by cultivation and hoeing.

Determination of yield: Corn weighed at husking time and weights reduced to dry shelled corn basis. Prior to 1931 they were based on air-dry shelled corn. Corn was allowed to dry about 30 days after shelling. In 1931 and 1932 weights were reduced to basis of shelled corn containing 12 per cent or less of moisture. The weight per bushel of dry shelled corn was considered as 56 pounds.

EXPERIMENTAL RESULTS

Varietal Investigations. Varietal investigations were started in 1922. During the 12 years that studies have been in progress more than 60 varieties and strains have been tested. These include varieties that are of importance in the Middle West and many local strains that have been grown and selected by good corn growers throughout the lower Yakima valley. Yield data from several varieties and strains are presented in Table 1. All the high yielding local strains are included in this table. These are shown by number and locality. They are used to show yields of various strains of local corn and not to indicate the value of any particular corn grower's seed. Since all varieties and strains were not grown for the entire period and since there were large differences in the annual yields for any given variety, average yields have little significance. Therefore, in order to compare varieties grown in different years, Reid Yellow Dent was used as a standard, and the yield of each variety was compared with that of Reid Yellow for the same years in which it was grown.

Table 1. Average Annual Yield of Corn Varieties and Strains, and the Comparative Production of Each, Reid Yellow Being Used as a Standard

Variety	Locality seed grown	Average yield in bushels per acre											No. years grown	Comparative production	
		1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932		Per cent	Bu. per A.
Reid Yellow	Iowa	30.0	59.9	41.3	51.4	65.3	60.1	62.8	64.5	85.9	43.6	87.3	11	100.0	59.3
Thayer Yellow	Prosser	32.9	64.5	56.6	56.4	57.3	51.5	54.4	58.4	59.8	46.1	75.5	11	94.1	55.8
Iodent	Iowa	30.5	56.5	43.2	57.2	61.2	62.0	53.7	61.4	84.2	40.6	80.4	11	96.7	57.3
Minn. 13	Minnesota	27.9	49.7	46.4	53.4	63.8	46.1	41.9	59.9	75.0	43.2	—	10	89.8	53.3
Windus White	Pullman	35.9	57.2	53.2	56.1	61.8	59.0	56.7	51.6	67.2	46.9	—	10	96.6	57.3
Silver King	Iowa	22.9	63.4	48.4	53.2	53.4	43.3	32.3	57.4	83.1	45.5	84.8	11	90.1	53.4
Johnson Co. White	Indiana	22 3	45.8	23.4	45 5	35.9	—	—	—	—	—	—	5	69.7	41.3
Rustlers White	Oregon	—	—	—	—	72.8	55.8	41.1	—	—	—	—	3	90.2	53 5
Minn. 23	Oregon	—	—	—	—	61.9	46.3	—	—	—	—	—	2	86.3	51.2
White Flint	Oregon	—	—	—	—	48.8	53.7	—	—	—	—	—	2	81.7	48.4
Local Yellow (1)	Prosser	—	—	47 5	46.2	69 5	62.4	62.4	59 5	—	38.2	101.1	8	102.2	60.6
(2)	Prosser	—	56.9	43.7	—	—	—	—	—	—	—	81.3	3	96.5	57.2
(3)	Granger	—	—	—	—	—	—	50.6	62.6	75.1	37 8	—	4	88.0	52.2
(4)	Wapato	—	—	—	—	—	—	—	58.1	61.7	—	—	2	79.7	47.3
(5)	Toppenish	—	—	—	—	—	—	—	45 9	71 8	39.5	93.0	4	88.9	52.7
(6)	Wapato	—	—	—	—	—	—	—	55 3	76.4	41.1	—	3	89.1	52.8
(7)	Sunnyside	—	—	—	—	—	—	—	—	75.4	42.1	88.8	3	95.2	56.5
(8)	Benton City	—	—	—	—	—	—	—	—	—	—	91.7	1	105.0	62.3
(9)	Kennewick	—	—	—	—	—	—	—	—	—	—	98.1	1	112.4	66.7

Each year, except 1922 and 1931, corn either followed alfalfa or the field was manured before corn was planted. In 1922 the plots were located on virgin soil. The plots in 1931 followed wheat and the field was not manured for either wheat or corn. It had been previously manured for corn.

Reid Yellow is one of the more commonly grown varieties in the Middle West and it was from this variety that many of the local strains of Yellow Dent have been developed. In a few cases local strains have been selected from Minnesota 13. Iodent, an Iowa product, has given almost as satisfactory results as Reid Yellow. Both of these varieties produced yields equal to or greater than most of the local strains that have been tested.

It is interesting to note that, with the exception of local strain No. 1, none of the local strains that have been grown for two or more years at the Station produced yields equal to Reid Yellow, the seed of which was secured from Iowa. The seed of this variety had been specially selected for high production and type. The yields secured show the result of this careful selection. The differences in yield between Reid Yellow and the better local strains were small and it appears that so far as the late maturing varieties and strains are concerned, well selected seed from good strains of local yellow can be used satisfactorily. On the other hand, seed corn which has not been carefully selected may be very expensive because of the reduction in yield that results from its use.

The extremely large, late maturing type of corn, as represented by Johnson County White Dent, proved inferior in yield of grain to other types studied. This particular variety was the lowest yielding variety each year it was grown.

When planted early in the season, late maturing varieties and strains usually outyield the early maturing varieties. On the other hand, the early maturing varieties have an advantage in that they require a shorter growing season and if planted early reach maturity much sooner than the late maturing varieties. For late planting the early varieties are superior. The choice of an early or late variety will depend upon the grower's requirements.

The early maturing varieties in Table 1 are Windus White Dent, Thayer Yellow Dent, and Minnesota 13. Both Windus White and Thayer Yellow are somewhat earlier than Minnesota 13 and have outyielded it rather consistently. Windus White has outyielded Thayer Yellow slightly, but the difference of 1.5 bushels per acre is not significant in view of the fact that the yellow corn is more desirable as a feed corn. Thayer Yellow has a small ear and the shortest stalk of any of the varieties that have been tested. It is capable of producing high yields on fertile soils.

In order to study the growth of corn in other corn-producing districts of the Yakima valley, five cooperative varietal trials were arranged in 1932. Locations ranged from Toppenish to Benton City and soil classes varied from silt loams to fine sandy loams. Thayer Yellow and either Reid Yellow or Iodent were grown at all locations. The local yellow seed used in each case was the same as the cooperator was using for his regular plantings. All plots were located in the cooperators' corn fields and those in any given location received the same treatment as the remainder of the field. The yields per acre for all plantings are shown in Table 2.

Table 2. Yield of Corn Varieties Grown at Various Locations in the Yakima Valley in 1932

Variety	Yield in bushels per acre				
	Toppenish	Outlook	Satus	Benton City	Sunnyside
Thayer	78.9	86.6	86.2	—*	73.8
Reid	74.5	101.9	—	76.4	89.7
Iodent	—	—	120.1	—	—
Local Yellow	72.8	93.3	96.8	93.6	80.7

* Thayer plot badly damaged by beavers and black birds. A representative yield, therefore, could not be obtained.

Results of all cooperative tests indicate that all locations shown in Table 2 are well adapted to corn growing. In these cooperative trials Reid Yellow and Iodent were superior to the local strains except at Benton City. The Benton City local strain also outyielded Reid Yellow and Iodent at the Station in 1932 as is shown in Table 1. The Toppenish local strain is a selection from Minnesota 13 and was outyielded at Toppenish by both Reid Yellow and Thayer Yellow. The comparative production of these three varieties at the Station also places the Toppenish local strain third. The Iodent plot near Satus was outstanding not only in yield but also in the maturity and uniformity of ears. Except at Toppenish, where Thayer Yellow outyielded Reid Yellow, the relative yields for varieties were similar to yields at the Station.

Corn Versus the Small Grains. In order to determine whether corn has a place on the irrigated farm it is necessary to know something of its production in comparison with that of crops with which it would compete or which it might replace. Since corn is primarily a grain crop the competing crops would be the small grains, including wheat, oats, and barley

The small grains have been grown at the Station since 1922. A former publication* reported the yields prior to 1930. One variety each of wheat, oats, and barley was used as a standard of comparison for all other varieties of the same crop. Reid Yellow and Thayer Yellow corn represent the two principal types of corn grown in the Yakima valley, and a direct comparison can be made between the yields of these two varieties and those of the aforementioned standard varieties of the small grains. Table 3 shows the average annual production of No. 1 grain in bushels and pounds per acre for each crop.

Table 3. Comparative Average Yields of Representative Varieties of Corn, Spring Wheat, Oats, and Barley

Grain	Variety	Number years grown	Av. yield in bushels per acre	Pounds per bushel	Av. yield in pounds per acre
Corn—Late	Reid	11	59.3	56	3321
Corn—Early	Thayer	11	55 8	56	3125
Wheat	Jenkin	11	48.5	60	2910
Barley	Blue	11	49.6	48	2381
Oats	Banner	11	72.3	32	2314

Although the corn and small grain varietal plots were not grown in the same field each year the difference in soil fertility for the average of the 12 years has not been great. During this time both corn and the small grains have been grown on soils of varying fertility ranging from virgin soils to soils that grew alfalfa the preceding year However the average soil fertility was slightly higher for corn than for the small grains. The small difference in soil fertility may have been sufficient to account for the difference in yield between Thayer Yellow corn and wheat, but it could hardly account for the entire difference in yield between Reid Yellow corn and the small grains. Since the highest annual yields for both corn and the small grains were obtained immediately following alfalfa, a comparison of these yields may indicate more clearly the relative yielding capacity of each. The highest yield that any small grain has produced at the Station is 4308 pounds per acre which was produced by Jenkin wheat. The highest corn yield is 5662 pounds per acre. This was produced by one local strain of Yellow Dent. The maximum yield for Reid Yellow was 4889 pounds per acre. All data available indicate that corn is capable of producing higher yields than the small grains.

* Bulletin No. 240, "The Production of Cereals Under Irrigation in Washington," by H. P. Singleton, 1930.

Acclimatization. In the Yakima valley it has been assumed by many growers that seed corn grown in the valley is superior to that grown in other districts. In Table 1 a comparison of Reid Yellow with the many local strains, most of which originally were Reid Yellow, indicates that the Station has secured little evidence to support this belief. The comparative yields of acclimated local strains and unacclimated Reid Yellow and Iodent in the cooperative trials as shown in Table 2 show no advantage for the local strains.

In order to determine more definitely the effect of acclimatization upon a variety of corn, Thayer Yellow corn was grown at the Station at Prosser in 1922 from Pullman grown seed and in 1923 two plots were grown, one from Prosser seed and one from Pullman seed. Each year following, plots were grown from all the preceding years' plots and a new plot of Pullman seed was added. In 1927 seed from the five plots that had been acclimated at Prosser from one to five years was tested at Pullman and Prosser. Table 4 gives the results of these trials at Prosser.

Table 4. Annual Yields of Thayer Yellow Corn Grown from Unacclimated Seed and from Seed Acclimated at Prosser from One to Five Years, and Comparative Production of Each, Unacclimated Seed Being Used as a Standard

Acclimatization of seed	Yield per acre						No. years grown	Comparative production	
	1922	1923	1924	1925	1926	1927		Per cent	Yield
Pullman	No	43.3	55.4	41.4	22.4	48 3	6	100 0	42.2
Prosser, 1 yr.	yield	35.5	55.0	50.4	24.2	49.4	5	101.8	43.0
Prosser, 2 yrs.	data		56.1	50.0	25.8	56 8	4	112.7	47.6
Prosser, 3 yrs.	obtained			42.9	28 8	53.7	3	111.9	47.2
Prosser, 4 yrs.					29.9	45 2	2	106.2	44.8
Prosser, 5 yrs.						49.8	1	103.1	43.5

It will be noted that there was very little difference in yields secured from Pullman-grown seed and from acclimated seed. In order to determine whether growing Thayer under the longer growing season at Prosser might have some influence in increasing the length of growing season required, seed from all corn plots was sent to Pullman where plots were grown from all lots of seed the following year. Results indicated that there was very little difference in yield and in stage of growth at any time during the growing season among plots grown from the different lots of seed.*

* Farm Crops section—information to author.

After conducting this work for six years it was felt that there may have been a possibility that cross pollination in the various plots influenced the following year's yield and that the data might not be entirely accurate. It was, therefore, decided to start a new trial. Pullman seed was planted at Prosser the first year. Each year thereafter seed from the preceding year's corn plot was used. One plot only was grown each year and since it was isolated from other corn fields there was no cross pollination with corn outside the plot. This plan was continued for five years and corn from all of the five plots was grown under the same conditions in 1932. Seed from the 1927 plots was available and plots from this seed were included. Table 5 shows the number of years acclimated, the year the seed was grown, and the yield for each lot of seed.

Table 5. Yields of Thayer Yellow Corn in 1932 Grown from Unacclimated Seed and from Seed Acclimated at Prosser from One to Six Years

Years acclimated	Years seed grown	Number ears per plot	Yield per acre in bushels	Average yield per acre
None	Pullman 1930	197	56.3	56.3
1	1927	201	58.3	
1	1928	197	53.9	56.1
2	1927	212	58.1	
2	1929	198	57.4	57.7
3	1927	196	58.1	
3	1930	218	66.3	62.2
4	1927	198	53.9	
4	1931	200	60.8	57.3
5	1927	211	65.0	65.0
6	1927	185	57.1	57.1

All plots from seed grown in 1927 are from the 1927 plots shown in Table 4. It will be noted that there is very little difference in the yields of the various plots. The small differences observed do not point toward any definite tendency because there was a difference of 0.8 bushel only between unacclimated seed and that acclimated six years. These data together with data presented in Tables 1 and 2 indicate that greater stress should be laid upon the securing of well matured viable seed of a known high-producing variety or strain than upon the number of years a variety or strain has been grown under irrigation in this state.

Time of Planting. The degree of maturity of any variety of corn is dependent to a large extent upon the time at which it is planted. The only time of planting trial made at the Station was conducted in 1926. Reid Yellow and Thayer Yellow were planted at two-week intevals from April 1 to July 1 inclusive. No yield data were obtained for the June 1 planting because a break in the Sunnyside canal made it impossible to irrigate before planting and the moisture available was insufficient to insure a good stand. Table 6 shows the planting dates and yields obtained.

Table 6. Yield per Acre of Two Varieties of Corn Planted at Various Dates

Date Planted	April 1	April 16	May 1	May 17	June 17	July 1
Variety	Yield in bushels per acre					
Local Yellow	73.5	80.5	88.8	103.6	31.2*	——**
Thayer Yellow	34.1	50.9	66.7	60.9	45.2	17.5*

* Corn very immature.
** Corn green. Kernel just forming.

An unusually late killing frost on May 24 severely damaged the plants of plantings previous to May 17 and probably reduced the yields to some extent. Both extremely early and late plantings resulted in reduced yields. Corn produced from late plantings was poor in quality.

Corn can usually be planted in the lower Yakima valley during the latter part of April and the early part of May. It is the practice of the more successful growers to plant as early as possible after most of the frost danger is past. The cooperative varietal trials in 1932 were planted at the time the cooperator planted his regular fields. Four of the five cooperators planted corn during the last week in April and the other during the first week in May. In no case, from the standpoint of yields, is a grower in the lower Yakima valley justified in delaying the corn planting after May 20. The early maturing varieties can be planted somewhat later than the late maturing varieties, but even they do not produce their best yields when planted late in the season.

Spacing of Rows and Plants. Observations of general farm practice in the Yakima valley as well as experience at the Station indicate that rows from 36 to 42 inches apart are satisfactory for large type corn, including Reid Yellow and many local strains, but that rows for Thayer should not be more than 36 inches apart. Little difference in yield has been observed in comparing checked corn with that drilled

in the row providing the number of plants per acre is the same. Drilling closer than 14 to 16 inches and checking more than three plants per hill may result in a large number of barren stalks and a reduction in yield of grain.

Irrigation. When the water requirement of crops commonly grown under irrigation is considered, corn and small grains require the least water. The total water requirement for the small grains and corn is about the same but, on account of the fact that the former takes more advantage of winter moisture and the cooler spring weather than the latter, the irrigation water requirement for corn is somewhat greater. Under conditions at the Station the average irrigation water requirement for corn, including farm transportation, runoff, and deep percolation losses, is slightly less than 30 acre inches.

The seed bed for corn must be sufficiently moist at the time the seed is planted to insure a good stand and rapid growth of plants until they are well established. Irrigation too soon after emergence retards plant growth and may cause reduced yields. On the fine sandy loam at the Station it is necessary to irrigate before planting but on some of the heavier soils there is usually sufficient winter moisture in the soil at planting time. The amount and frequency of irrigation throughout the growing season will depend to a large extent upon soil type and climatic conditions. A supply of available moisture in the soil must be maintained so that plants do not suffer from lack of water. On most soils three irrigations after planting are sufficient. On heavier soils two irrigations may be adequate.

All corn irrigation is done by the furrow method. Ditcher shovels are used on the cultivator to make the furrows and they are so set that one furrow only is left between rows. The ditches made at the last cultivation remain throughout the growing season.

Cultivation. Cultivation investigations were conducted in 1924, 1925, 1926, and 1927. The different systems of cultivation ranged from no cultivation to cultivation every seven days until the corn matured. In 1926 a plot was added in which there was no cultivation and on which the weeds were not pulled. Table 7 shows the different methods of cultivation used and the annual yields obtained from the various trials.

Differences in yield were not significant on the various plots from which the weeds were removed either by pulling or by cultivation. However, on plots where the weeds were allowed to grow, the yield was reduced in proportion to the stand of weeds. In 1926 a heavy stand of weeds reduced the yield by more than 60 per cent, whereas in 1927 a light stand of weeds reduced the yield only 6.5 per cent.

Table 7. Average Annual Yields of Local Reid Yellow Corn Grown under Various Methods of Cultivation

Method of cultivation	Yield in bushels per acre				
	1924	1925	1926	1927	4-year average
No cultivation—pull weeds	66.8	55.6	31.3	74 4	57.0
No cultivation—leave weeds	——	——	12 3	69.6	——
Moderate cultivation until corn shades ground	55 7	49.2	51 5	77 3	58.4
Cultivation until corn is matured	52 1	52 8	49.4	77 9	58.0

The soil at the Station is a fine sandy loam and does not bake or crack upon drying. On this particular type of soil it appears that the main value of cultivation is in killing weeds. However, in order to grow a good yield of corn it is very essential that no weeds be allowed to grow because they greatly reduce the amount of moisture and plant nutrients that are available. On some of the heavier soil types cultivation may be necessary to prevent baking and cracking of the soil following irrigation. The amount of cultivation necessary, however, will be only such as is required to keep the soil in good physical condition and to prevent weed growth.

Soil Fertility. Fertile soils are necessary for corn production if high yields are to be secured. In 1922 a series of plots was established on virgin soil at the Station on which a crop rotation system consisting of potatoes, corn, and wheat was used to determine crop responses to the application of various fertilizers. There were 10 plots in the original series, two of which were used as check plots and have never received fertilizers. Two plots now receive an annual application of manure, one receiving sheep manure and the other horse manure. Prior to 1927 each had received an application once in three years only, made just previous to potatoes. The experiment has been continuous and the plots have grown corn in 1923, 1926, 1929, and 1932. The variety used has been Thayer Yellow. Table 8 shows the average yield of corn per acre for the two check plots and the two plots fertilized with manure. It also shows the average yield of Thayer Yellow from the varietal plots for the same years. The corn varieties were grown following alfalfa each year that yields are shown in the table.

The four-year-average yield of plots receiving manure was 242 per cent of that of the check plots. The yield of corn following alfalfa was even greater, these plots producing an average yield equal to 334

Table 8. Average Annual Yield of Thayer Yellow Corn Grown on Plots Receiving No Fertilizer, Those Receiving Manure, and Those Growing Corn Following Alfalfa

Fertilizer treatment	Average yields in bushels per acre				
	1923	1926	1929	1932	4-year average
No fertilizer	25.8	14.4	13.9	22.5	19.1
Manure	44.9	31.0	55.4	54.0	46.3
Following alfalfa	64.5	57.3	58.4	75.5	63.9

per cent of the average check plot yield. Each year the seed for all plots was from the same source and it can readily be seen that the check plots, being low in fertility, were unable to produce over 30 per cent of the yield that the variety was capable of producing.

Silage. Field yields of silage from local strains of Reid Yellow have ranged from 10 to 15 tons per acre on the field basis. Grain yields for similar corn have ranged from 50 to 75 bushels per acre.

Yields much higher than 15 tons per acre have been reported frequently throughout the Yakima valley. Some of these are for a very large type of corn and some for very immature corn. Yields at the Station were determined when the kernels were well dented. Cutting at this stage of growth has produced an excellent grade of silage.

Comparative Feeding Value of Eastern Corn, Local Corn, and the Small Grains.* The yield of grain per acre is not the whole story of the relative desirability of corn or the small grains. Grains as feed for livestock vary considerably in feeding value per unit weight.

In order to determine the relative feeding value of various grains, feeding investigations have been conducted at various times since 1922. Lambs have been used in these experiments. All grains were fed at the same rate for any given year. Alfalfa hay was fed to all lots for the entire period. The grains that have been fed are Eastern corn, local Reid Yellow corn, Thayer Yellow corn, Turkey wheat, Jenkin wheat, Baart wheat, barley, and oats.

Since this publication is not primarily one on feeding, only specific data will be presented. The amount of feed necessary to produce

* All feeding trials were conducted under projects approved by the Division of Animal Husbandry, State College of Washington. For experimental methods in feeding experiments see:
Bulletin No. 185, "Lamb Feeding Experiments," by H. Hackedorn, R. P. Bean, and J. Sotola. November, 1924.
Bulletin No. 258, "Lamb Feeding Experiments," by H. Hackedorn, J. Sotola, and H. P. Singleton. September, 1931.

gains on livestock indicates the feeding value of any particular feed, and is of interest to the grower of the crop. Table 9 shows the year feeding trials were conducted, the amount of feed required per hundredweight of gain, and the average daily gain per animal.

Table 9. Average Daily Gain and Feed Requirements per Cwt. Gain for Lambs Receiving Various Grains as a Supplement to Alfalfa Hay

Year	Grain fed	Average daily gain	Feed required per cwt. gain	
			Chopped hay	Grain
1924-25	Eastern corn	.361	792	274
	Local Reid corn	.338	884	295
	Barley	.273	1052	367
	Oats	.279	1023	359
	Wheat	.295	967	339
1930-31	Eastern Corn	.354	483	304
	Local Thayer corn	.354	483	304
	Barley	.302	587	355
	Wheat	.325	542	331
	Oats	.280	626	384
1931-32	Local Reid corn	.340	460	346
	Local Thayer corn	.378	414	312
	Jenkin wheat	.270	379	421
	Turkey wheat	.281	562	419
	Baart wheat	.306	511	384
	Barley	.327	478	360
	Oats	.267	586	440

In 1924-25 and 1931-32 local grown Reid Yellow corn was fed. In each case less grain and hay were required to produce 100 pounds gain than for the small grains and the average daily gain was greater. Eastern corn was also fed in 1924-25 and had somewhat greater feed value than the local Reid Yellow. This was due largely to the difference in moisture content, the eastern corn having been grown in 1923.

The feeding value of Thayer Yellow corn was compared with that of eastern corn in 1930-31 and was equal to it in every way. Both produced greater average daily gains than wheat, oats, or barley, and feed requirement per 100 pounds of gain was much less for each than for any of the small grains.

The feeding trials in 1931-32 included local Reid Yellow and Thayer Yellow corn, three varieties of wheat, and one variety each of

barley and oats. The Reid Yellow contained 19 per cent moisture, the Thayer Yellow 14 per cent, and the small grains from 8.8 to 10.6 per cent. On the basis of gains produced, one ton of Thayer Yellow corn was equal to 2308 pounds of barley plus 410 pounds of alfalfa hay. The comparative value of a ton of local Reid Yellow corn was 2081 pounds of barley plus 104 pounds of alfalfa hay. Barley ranked next to the corn varieties in feed value. Therefore, the replacement value of corn for other small grains was even greater than for barley.

No experimental evidence is available regarding the feeding value of local corn containing more than 19 per cent moisture. Corn containing a greater amount of moisture would probably be difficult to store. However, suitable varieties planted early in the season will mature before husking time. No doubt some of the difficulties livestock men have experienced with local corn have been due to the use of immature corn. Usually immaturity is due either to the use of a very late maturing variety or to late planting.

The significant points brought out by Table 9 are, first, that good local corn is superior to the small grains for fattening lambs and, second, that local grown corn carrying the same moisture content as eastern corn is equal to it in feeding value.

Silage Versus Other Succulents for Fattening Lambs and Beef Cattle. In any discussion of the utilization of corn the value of corn for silage must be considered. During the time the Station has been in operation corn silage has been used each year for livestock feeding. Several feeding trials have been conducted to determine the feeding value of corn silage for fattening lambs. Since other succulent farm crops also are commonly used as supplements in livestock rations, feeding trials with a number of them have been made. The silage used in all these trials was from fields that would average 50 to 75 bushels of No. 1 shelled corn per acre if allowed to mature, and about 10 to 15 tons of silage as it came from the field. The corn was put into the silo when the grain was well dented. Water was supplied in the distribution pipe in sufficient quantities to produce an excellent grade of silage. All other succulent crops were carefully sorted for rot and were fed chopped, with the exception of potatoes which were fed whole in 1931-32 and 1932-33. The following table shows the feeds fed, feed requirements per hundredweight gain, and the amounts of hay and grain replaced by the various succulent crops. Data are shown for all feeding seasons in which comparisons of silage and other succulent crops were made.

This table gives in detail the results for each year during which the trials were conducted. It is difficult to average results of different years because different proportions of grain, hay, and succulents were used in the ration. Climatic conditions also cause some fluctuation

Table 10. Average Daily Gain, Feed Required per Cwt. Gain, and Hay and Grain Replaced by Various Succulent Crops When Each Was Fed to Lambs as a Supplement to Hay and Grain

Year	Succulent	Grain Fed	Average daily gain	Pounds of feed required per cwt. gain			Pounds feed replaced per ton of succulents	
				Succulent	Chopped hay*	Grain	Hay	Grain
1927-28	Check	Wheat	.282	None	777	341	——	——
	Silage	Wheat	.296	490	594	325	747	65
	Potatoes	Wheat	.337	430	582	285	907	260
	Apples	Wheat	.302	480	550	318	946	96
	Carrots	Wheat	.311	467	660	309	501	137
1930-31	Check	Barley	.307	None	592	350	——	——
	Silage	Barley	.324	275	479	332	822	131
	Potatoes	Barley	.346	258	449	311	1109	302
	Apples	Barley	.316	283	496	341	678	64
1931-32	Check	Wheat	.306	None	511	384	——	——
	Silage	Wheat	.323	328	432	349	482	213
	Potatoes	Wheat	.358	296	390	315	818	466
	Apples	Wheat	.355	298	393	318	792	443
1932-33	Check	Corn†	.312	None	598	297	——	——
	Silage	Corn	.341	413	455	272	692	121
	Silage[1]	Corn	.361	551	369	257	831	145
	Potatoes	Corn	.365	407	447	254	742	211
	Potatoes[1]	Corn	.339	593	400	273	668	81
	Apples	Corn	.360	413	454	258	697	189
	Apples[1]	Corn	.259	741	506	357	248	—162[2]
	Squash[1]	Corn	.321	635	426	289	542	25
	Carrots[1]	Corn	.331	634	422	280	555	54
	Rutabagas[1]	Corn	.320	655	436	290	495	21

* In cases where long hay was fed the amount of hay consumed was used in this table.

† Local grown Thayer Yellow corn was fed to all lots.

[1] In 1932-33 these succulent crops were fed at heavy rates of feeding, 2 pounds of each being fed to 1 pound of hay. In all other years and in remaining lots in 1932-33 they were fed at light rates, the ratio being not greater than 1 pound of the succulent crop to 1 pound of hay.

[2] More grain was required per 100 pounds gain for the lot receiving heavy apples than for the lot receiving grain and hay only. Therefore, apples, at the heavy rate of feeding, had a negative replacement value for corn.

in results. Taking the results as a whole, under all variations of rations and climatic conditions silage had a high replacement value. Of equal interest is the comparison between silage and other succulent crops. All other succulent crops had high replacement values and in most cases these were equal to or greater than that of silage.

The cash value of any succulent crop for lamb feeding can be computed by multiplying the pounds of hay and grain replaced by the actual cash value per pound of each and adding together the value of the hay and grain replaced.

All trials reported herein were with lambs. However, it has been the experience of many dairymen in the Yakima valley that succulents other than silage are also desirable feed for dairy cows.

GENERAL CONSIDERATIONS

Corn is a crop that fits well into the management of a general irrigated farm. Most of the operations do not interfere with those for hay, pasture, or small grain crops. Corn has another advantage in that it does not require a large capital outlay for machinery. A good planter and cultivator are the only items of special machinery required for corn production for grain.

The amount of seed required for corn is very small compared to the small grains, and good seed can be secured at a much smaller cost per acre than for them. Corn has another advantage in that most of the labor for the production and harvesting of the crop can be handled by the farmer himself. In the case of the small grains harvesting must be done at a time when labor is scarce and wages relatively high whereas with corn the harvesting can be done during the late fall and winter months.

The choice of variety will depend upon location and on type of corn desired. In the lower Yakima valley the large type corn, as represented by Reid Yellow and its local strains, will produce somewhat higher yields than the early maturing varieties. However, if early maturity is essential an early maturing variety such as Thayer Yellow should be used.

Very little corn has been grown in Kittitas county but some of the early maturing varieties, especially Thayer Yellow, showed considerable promise* in a test conducted by County Agent W. O. Passmore It appears than only early varieties can be depended upon to mature in Kittitas county.

It is essential that good seed corn be used if high production is to be otained. Seed corn should be mature and should be stored inside

* Information to the author.

a building. Testing of seed corn in the spring is very desirable. Good stands are necessary for maximum production.

The question whether silage pays often arises. A comparison of the feeding value of silage and a number of other succulent crops indicates that all had high feeding values and that the choice of any one of them would probably depend upon factors other than the relative feeding value.

With the exception of silage all succulent crops fed were waste products of the farm since they were classed either as second grade or as culls. The feeding of such crops affords one way of disposing of them at a fair price; therefore, if sufficient of these waste products are available, silage could hardly compete with them on the basis of cost of production per ton.

Silage is a product that is not well adapted to the small operator. Equipment to handle silage is relatively high priced and is used for only a short time each year. The silo is also relatively high in value as compared to storage for other succulent crops. Silage has another distinct disadvantage in that a sufficient depth of silage must be fed daily to prevent spoilage The man with a small number of livestock must therefore have a small silo.

The yields of some of the succulent crops studied, such as carrots, rutabagas, potatoes, and squash, are considerably above the average yield of corn silage, and in years of extremely low prices the entire crop could be fed on the basis of market prices at a cost less than that of corn silage.

Corn silage is excellent feed and has its place with the large operator who has no waste succulent crops and who has sufficient livestock to justify the expense of silos and equipment. On the other hand, it is not logical to assume that the average small operator will become interested in growing corn for silage. The empty silos in the irrigated districts of the state stand as witnesses to this fact.

SUMMARY

1 Corn has been of relatively small importance in the state, there being only 32,500 acres in 1929, about half of which was grown under irrigation.

2. Both early and late maturing varieties have outyielded all small grains over an 11-year period

3 Both early and late maturing varieties have had greater feed value per ton than any of the small grains

4 Local grown corn with the same moisture content as eastern corn has equal feeding value

5. Thayer Yellow and Windus White outyielded other early maturing varieties.

6. Later maturing varieties, including Reid Yellow, Iodent, and good local yellow strains, have been somewhat superior to early strains in yield.

7. Johnson County White and other extremely long season varieties have no place under irrigation in this state as grain crops.

8. Cooperative trials with corn in 1932 at Toppenish, Outlook, Satus, Benton City, and Sunnyside gave results similar to those at the Station.

9. Little or no value could be determined for the acclimatization of early or late maturing varieties to conditions in the Yakima valley.

10. All corn should be planted as soon as frost danger is past. Early maturing varieties will mature when planted at a later date but yields will be reduced.

11. Large varieties of corn require greater space per plant than the smaller, early maturing varieties. Rows 36 to 42 inches apart are suitable for Reid Yellow, while rows 36 inches or even less are more satisfactory for Thayer.

12. The irrigation water requirement of corn is not high, a total application of 30 acre inches being sufficient to produce good yields in the fine sandy loam soil at the Station.

13. On the fine sandy loam soil at the Station, cultivation has been of little benefit except in killing weeds.

14. Weed growth must be controlled by cultivation and, in extreme cases, by hoeing. Allowing weeds to grow has decreased the yield by as much as 60 per cent.

15. Corn requires a fertile soil.

16. Corn for silage has about the same value when fed to fattening lambs as cull potatoes, cull apples, carrots, squash, or rutabagas.

17. Corn fits well into the cropping system on the irrigated farm.